

style, and technical terms have been used sparingly. There is, however, no reason why the term "flea larvæ" should not have been employed instead of "tiny fleas" (p. 48), which is rather misleading. The introductory chapter deals with the structure and characters of the chief classes of Protozoa, and the ways by which the parasitic forms gain access to their hosts. The next chapter is on trypanosomes and their relation to tsetse-flies, and is followed by an account of the life cycles of the flagellate parasites *Crithidia* and *Herpetomonas*, which occur normally in the gut of fleas, lice, etc., and are liable to be confused with certain phases of blood-parasites. In the section on *Spirochætes* considerable attention is devoted to the vexed question of the shedding of granules. The authors have studied the granules in the large *Spirochætes* from molluscs and regard them as "spores," and consider "that the balance of evidence is somewhat in favour of the inclusion of the *Spirochætes* among the Protozoa."

In the account of malaria the interesting statement is made that within the last few years the authors have seen malarial parasites in the blood of children suffering from ague in the Fens, and have been able to secure specimens of *Anopheles maculipennis* "in whose stomachs cysts occurred and whose salivary glands teemed with sporozoites [of malaria]."

Eimeria (Coccidium), the organism of coccidiosis in birds, is fully described, and measures are indicated for preserving domestic poultry and hand-reared game-birds from the attacks of this parasite. The following chapters deal with *Entamoeba* in man, *Babesia* (*Piroplasma*) in relation to "red water" in cattle, *Theileria*—the organism of East Coast fever in cattle in Africa, *Leishmania* in relation to kala azar, infantile kala azar and Oriental sore, microsporidiosis of bees (Isle of Wight bee-disease), various Protozoa parasitic in fish, the nasal parasite (*Rhinosporidium*) of man, and the parasite (*Sarcocystis*) of striped muscle. The two concluding chapters contain interesting accounts of the relations of parasitic Protozoa with their environment, their effects on their several hosts, and the economic importance of the study of Protozoa.

Throughout the work the authors have considered preventive measures, and have pointed out their prime importance in the fight against parasitic Protozoa.

The volume is illustrated by clearly-drawn text-figures; the magnifications of these figures might have been stated, as in the absence of such statement the general reader is apt to acquire an exaggerated idea of the size of, say, a *Spirochæte*.

The authors, who have themselves taken a considerable share in the investigation of several of the organisms described, have succeeded in giving a clear, accurate, and interesting account of the principal Protozoa which have been proved to exert so malign an influence on man and to limit his activities in ways innumerable.

GENERAL AND SPECIAL PHYSICS.

- (1) *Sound. An Elementary Text-book for Schools and Colleges.* By Dr. J. W. Capstick. Pp. vii + 296. (Cambridge University Press, 1913.) Price 4s. 6d.
- (2) *Die Brownsche Bewegung und einige verwandte Erscheinungen.* By Dr. G. L. de Haas-Lorentz. Pp. 103. (Braunschweig: F. Vieweg und Sohn, 1913.) Price 3.50 marks.
- (3) *Photo-Electricity. The Liberation of Electrons by Light.* By Dr. H. Stanley Allen. Pp. xi + 221. (London: Longmans, Green and Co., 1913. Price 7s. 6d. net.
- (4) *Course de Physique Générale. Leçons professées à la Faculté des Sciences de l'Université de Lille.* By H. Ollivier. Tome Premier. Unités. Gravitation. Electricité et Magnétisme. Ions et Electrons. Symétries. Pp. 716. (Paris: A. Hermann et Fils, 1913.) Price 18 francs.

(1) **T**HIS text-book is one that many teachers will find suitable for recommending to students in their degree courses preparing for examination in sound. It is always gratifying to find the writer of a text-book on sound with some considerable knowledge of the fundaments of music. Dr. Capstick certainly does pay attention to this aspect of the subject and from this point of view there is nothing but praise to be said of it. In his first chapter he introduces the idea of intervals, and later he gives some very interesting chapters on consonance, musical instruments, and scales and temperaments.

In the parts that relate more especially to the physics of the subject, readers will not be quite so much at ease. There is a tendency for the theoretical treatment to lack clearness, and students reading for the first time will often be driven to consult a teacher. The same cannot be said of the descriptive parts of the subject, for these are treated in a very interesting way. In a book of this scope though, it is questionable whether it is a wise plan to follow Barton in consigning all account of acoustical measurements to one chapter. These would be much more in place if treated separately in connection with the theoretical treatment to which each applies. The descriptions in this chapter are undoubtedly good, and it is inter-

esting to find there some account of intensity and audibility measurements and also of experiments to test the theories of vowel sounds.

The value of the book is increased greatly by an excellent collection of examples.

(2) This work on the Brownian movements is the outcome of a dissertation of the author, which was an account of a new method of attacking the theory of the subject. This method in itself seems to open a very promising field, for it can be applied to various branches of physics. Its application to Brownian movements consists in putting down the equation of motion of a particle in the form

$$m \frac{du}{dt} = -wu + F,$$

where w is given by Stokes's formula, $w = 6\pi\zeta a$, and F is a force which alters in direction in an irregular manner due to collisions with the molecules of the liquid. The mean velocity of a particle is calculated after n collisions, and it is shown how the influence of the initial motion diminishes in importance as n increases. Then the mean distance that a particle gets from its starting point in time t is calculated, and this comes to be exactly the same as that calculated by Einstein, whose formula has been experimentally verified.

An example of the application of this method is to calculate the energy of a magnetic needle at the centre of the coil of a tangent galvanometer due to a succession of small impulses of current in the coil. Some other applications are given, one of which has been worked out by Prof. H. A. Lorentz.

The work includes an account of the history of the development of our knowledge of the Brownian movements. The methods and results of the most important experimental researches on the subject are given and the theories of Einstein, Smoluchowski, and others discussed. The work of Millikan and others on the Brownian movements in gases is given a prominent place.

The new method of treating this interesting subject will be found instructive. Also from the point of view of a general treatment it can be recommended to all seeking a connected account of work on Brownian movements.

(3) Under the heading Photo-Electricity, is usually understood the emission of electricity from a metal surface when light falls on it, and the present volume is the first to be published which is devoted almost entirely to that subject. Dr. Allen, however, also includes in his book certain other subjects that are allied to the main one, such as fluorescence and phosphorescence, photo-chemical actions, and photography. Other relations between electricity and light such as the alteration

of the resistance of selenium by light are not discussed. This is quite easy to understand, for the author had quite a large task without that.

Anyone who wishes to obtain a good account of the photo-electric effect ought to read this book. The subject is treated historically so far as possible, and a very clear account of the principal experimental work on the subject is given. The whole subject is so vast that the author is to be congratulated for having collected such a mass of results as he has done. There is a clear account of the methods for measuring the photo-electric current and the velocities of the electrons. The chief results for metals and solids and fluids generally are given. An exceedingly interesting chapter on the effect for gases comes about the middle of the book, and the importance of this in general physics is indicated, such as, for instance, the ionisation of the upper atmosphere.

Perhaps the most difficult task for the author was to give an account of the theories which have been advanced, and to decide on one as the most probable. In the present state of the subject Dr. Allen has taken the wisest course in deciding that the selective effect points to a resonance between the light and the electrons in the molecules, and indicating that the normal effect is most probably due to the same cause.

Readers will find the chapter on fluorescence and phosphorescence very interesting. A very clear account of Stark's and Lenard's views on these subjects are given. So also will practical photographers be interested in the chapter on photography. But the chief importance of the book is its value to the physicist who has not time to read through all the literature on photo-electricity and wishes to get a connected account of it.

(4) This is the first of three volumes which give in book-form the substance of a course of lectures on general physics at the University of Lille, 1911-13. The present volume is devoted chiefly to electricity and magnetism, which is treated under the headings Electrostatics, Magnetism, Current Electricity, and Electrons and Ions. In addition there are chapters on Gravitation and the Symmetry of Systems. Every part is treated so as to introduce the newest results. New work like the diffraction of X-rays by crystals, Barkla's work on X-rays, C. T. R. Wilson's photographs of the paths of single ions, and the magneton theory follow so logically each in its place, that one does not find it strange to see these newest developments in a general text-book. Many students will find the book of value because of the very clear account given of the most modern work in physics.

One new subject introduced is the symmetry of systems, which is really a summary of the work of P. Curie, and English readers will be thankful for having so easy a means of acquiring a knowledge of this important subject.

The book does not pretend to be an encyclopædia of physics, but it treats of the whole subject so as to bring students up to a standard when they can feel confident in taking up research on some definite subject. In other words, it meets the requirements of the standard of the Honours B.Sc. Examination. The whole book is clearly written, and teachers will have no hesitation in leaving students alone with it.

Another excellent feature is the treatment of a gravitational field first, and then later an electrostatic field where it is only necessary to give analogies with the former case. Here, generally, the Cartesian notation is used, but the Vector notation is explained without much use being made of it.

One of the most striking drawbacks of the book is the lack of an index. J. R.

LOGIC, TEACHING AND PRACTICE IN MATHEMATICS.

- (1) *The Algebra of Logic*. By Louis Couturat. Authorised English Translation by Lydia G. Robinson. With a Preface by P. E. B. Jourdain. Pp. xiv+98. (London and Chicago: The Open Court Publishing Company, 1914.) Price 3s. 6d. net.
- (2) *An Algebra for Preparatory Schools*. By Trevor Dennis. Pp. viii+155. (Cambridge University Press, 1913.) Price 2s.
- (3) *Test Papers in Elementary Algebra*. By C. V. Durell. Pp. viii+233. (London: Macmillan and Co., Ltd., 1914.) Price 3s. 6d.
- (4) *Practical Mathematics for Technical Students*. Part I. By T. S. Usherwood and C. J. A. Trimble. Pp. 370. (London: Macmillan and Co., Ltd., 1914.) Price 3s. 6d.
- (5) *A Text-book on Spherical Trigonometry*. By Prof. R. E. Moritz. Pp. vi+67. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1913.) Price 4s. 6d. net.
- (6) *Plane and Spherical Trigonometry* (with Five-Place Tables). By Prof. R. E. Moritz. Pp. xvi+357+67+96. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1913.) Price 10s. 6d. net.

(1) **T**HIS is an excellent translation of M. Couturat's well-known "Algèbre de la Logique." The conciseness and modernity of M. Couturat's book is very apparent when we
NO. 2333, VOL. 93]

compare it with the first two volumes of Schröder's bulky, prolix, and somewhat antiquated work. The book under review is, as is remarked in the preface (p. viii.; cf. pp. 92-93), an exposition of the beautiful and simple calculus of symbolic logic, regarded as a branch of universal algebra. Leibnitz distinguished the two most important aspects of a symbolic language designed for purposes of reasoning, under the names *calculus ratiocinator* and *characteristica universalis*: the latter indicates broadly the route taken by Frege, Peano, Russell, and Whitehead; the former the route taken by Boole, Jevons, Venn, Schröder, and others, and is that described in the present work. Between these two routes, the "logic of relations" lies, and this is not dealt with here; but we are given a complete presentation of the important modern work of Whitehead (1898, 1901), Johnson (1901), Poretsky (1899-1904), and Huntington (1904) on the logic of classes and propositions. Miss Robinson has added several valuable notes to her translation. The volume is neat and handy, and is an important addition to our English mathematical literature.

(2) "The development of the subject is based on psychological rather than logical principles." Here we have a sensible admission of the relation in which a text-book should stand to a scientific treatise, which the text-books of the past helped to obscure. The book consists of a series of graduated papers which exactly follow the lines of the syllabus issued by the curriculum committee of the Headmasters' Conference, and approved by the general committee of the Mathematical Association for all boys, except mathematical specialists, in public schools. There is no "book-work," and the subject is developed wholly by means of examples; but some attempt has been made to give the pupil an impression of the existence of foundations of the subject and some sense of their nature. The very first question of the book is rather characteristic: "A boy has 5*d.* and is given 3*d.* How much has he now? How much has he if he had 5*d.* and receives *x* pence? . . .", and so on. The last question of this paper is: "Make up more questions like these and give the answers." This is an excellent way of teaching, and there is a freshness about the book.

(3) This is a collection of papers designed primarily for out-of-school work, and consequently includes only few graphical questions. The papers follow the traditional course of elementary algebra, along the thorny path of quadratics, logarithms, the progressions, combinations, and easy probability, up to the giddy heights of